

NEW DESCRIPTIONS

A NEW FAIRY SHRIMP SPECIES, *BRANCHINELLA NALLURENSIS*
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The current study identifies a new fairy shrimp, which belongs to the genus *Branchinella* from Chengalpattu, Tamil Nadu, India. Morphological variation was observed in frontal appendage, second antennae, penal structure in male and egg ornamentation in female justifying this as a new species, *Branchinella nallurensis*. The variation observed in the present study was confirmed by comparing with the well known species, *B. kugenumaensis* (Japan) and *B. madurai*.

Key words: *Branchinella kugenumaensis*, *B. madurai*, *B. nallurensis* sp. nov., egg ornamentation, new species, second antennae, penal morphology

INTRODUCTION

Fairy shrimps belong to the genus *Branchinella* (Anostraca: Thamnocephalidae) Sayce 1902, are widely distributed all over India (Linder 1941; Quadri and Baqai 1956; Tiwari 1965; Bernice 1972). *Branchinella kugenumaensis* (Ishikawa 1895) is originally identified as endemic from Japan and is now reported to occur in majority of Asian countries. Based on the size, number of protruberances in the second antennae and frontal appendage in Japanese population, Raj (1951, 1961) described the Indian population as a new variety, *B.k. var. madurai*. The status of *B.k. var. madurai* has been rejected by various researchers (Radhakrishna and Prasad 1976; Belk and Esparaza 1995). Despite these rejections it gained species status due to the tremendous contribution of Brendonck and Belk (1997), who named it as *B. maduraiensis* Raj. Recently, the nomenclature for this species is further corrected as *B. madurai* (Martin and Boyce 2004). Based on a detailed morphological comparison to *B. kugenumaensis* and *B. madurai*, *B. nallurensis* nov. sp., is identified and reported in this study as a natural population of *Branchinella*.

MATERIAL AND METHODS

About twelve animals were collected from Nallur village (12° 42' N; 80° 01' E), Chengalpattu, Tamil Nadu, India during May 1997. The species was collected repeatedly during 1998 and 1999, and invariably showed the same morphology as the species reported from Madurai and Japan. For observation purposes, they were brought to the laboratory and fixed in 4% formalin. Holotype male (3.1 cm) and females (3.2 cm) (UM/DZ/NM/FS 150 to 153) were used to study

the morphology. Total of five males (2.8-3.6 cm) and seven females (3.0-3.4 cm) (paratypes) were observed and some specimens were deposited in the Zoological Survey of India (Cat # CA1ZSI/SRS).

RESULTS AND DISCUSSION

Frontal appendage is divisible into three regions (Fig. 1). The first part (basal) consists of 17-22 protruberances, spiniform proximally and digitiform distally. Spines are seen at the base of frontal appendage and in between the second antennae. The second part (middle) branches out into two, one at the upper region and the other in the lower part armed ventrally with two rows of 16-22 widely spaced tubercles (Fig. 1). Rami, the third part consist of 3-4 strong spines in their ventral region. Each ramus is long, ensiform medial side branch with spines on entire surface and one prominent spine at the base. Lateral side branch (2L) equals to the main branch (1M) and with spine at the tip (Figs 1, 2).

Dorso-lateral surface of the second antennae consists of about 22-27 digitiform tubercles (Fig. 1). The second antenna is divisible into apical (aj) and basal joint (bj) (Figs 1, 3). Basal joint consists of a row of 3-5 tubercles situated medially (Fig. 1). Medial antennal process (MAP) reaches to the middle distal joint of antennae and are set with 9-10 long ventro-medial protruberances of which 5-6 are bifid and located ventro-medially, 3 are anvil-shaped and 1 is digitiform located distally (Figs 1, 3). Eight long spiniform protruberances observed, are located on the dorso-medial surface (Figs 3, 4).

Antennal morphology of several species has been proved as a valid character in taxonomy (Daday 1910; Linder 1941; Brtek 1974; Maeda-Martinez *et al.* 1995; Velu and

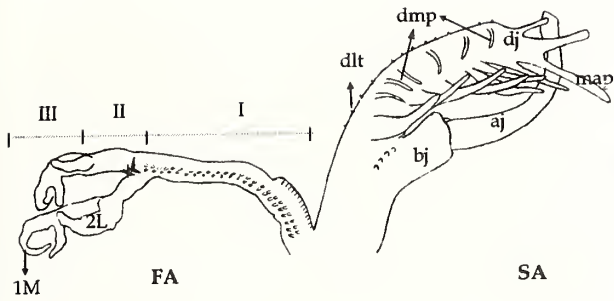


Fig. 1: Camera lucida diagram showing the frontal appendage and second antenna (outer and inner view) of male *Branchinella nallurensis*. sp. nov. aj – apical joint; bj – basal joint; dj – distal joint; 1M – 1 main branch; 2L – lateral branch; sp – spines; FA – frontal appendage; SA – second antennae; map – medial antennal processes; dmp – dorso-medial processes; dlt – dorso-lateral processes; I, II, III – 1st, 2nd, 3rd Segment

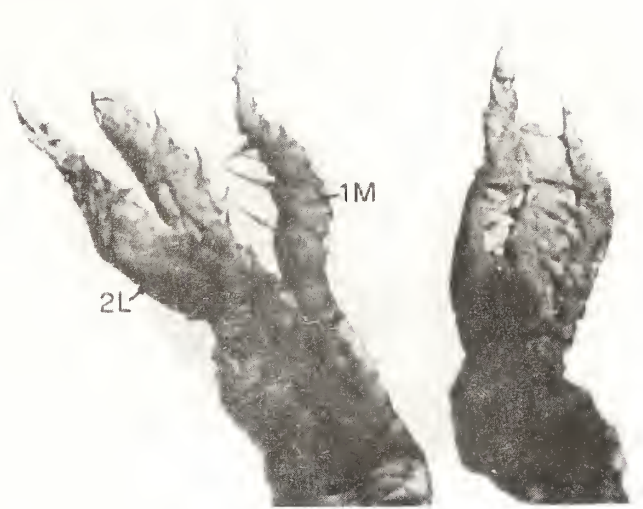


Fig. 2: Light microscopic photograph showing the rami of frontal appendage in male. 1M-main branch; 2L-side branch



Fig. 3: Light microscopic photograph showing the inner lateral view of second antenna of male *Branchinella nallurensis* sp. nov.



Fig. 4: Higher magnification showing the dorso-medial protuberances (p) on the second antenna

Munuswamy 2005). *B. madurai* Raj gained species status mainly based on the morphology of male second antennae, genital structure and egg ornamentation. A significant difference in the size of 1M branch of frontal appendage and morphology of ventro-medial protuberances in the antennal process was observed (Brendonck and Belk 1997). Using the

same criteria, we distinctly show the variation between *B. nallurensis* and other species (Tables 1-3). In addition, the side branch 2L of the frontal appendage reach the tip of main branch 1M, the digitiform protuberances on the medial side of basal antennal joint resembles that of *B. madurai*. The third section, ramus, in the *B. nallurensis* show spines on their

Table 1: Morphological variations observed in the frontal and second antennae of *Branchinella* species

	<i>B. kugenumaensis</i>	<i>B. madurai</i>	<i>B. nallurensis</i> sp. nov.
Dorso-medial process	6 spiniform	7 digitiform	8-9 spiniform
Medial antennal process	10 digitiform protuberances, 7 ventro-medial, 3 distal	8 long protuberances, 5 bifid ventro-medially, 3 anvil-shaped distally	9 long protuberances, 6 bifid, 3 anvil-shaped distally
Medial side of basal joint	6 tubercles	3 small tubercles	8-10 tubercles

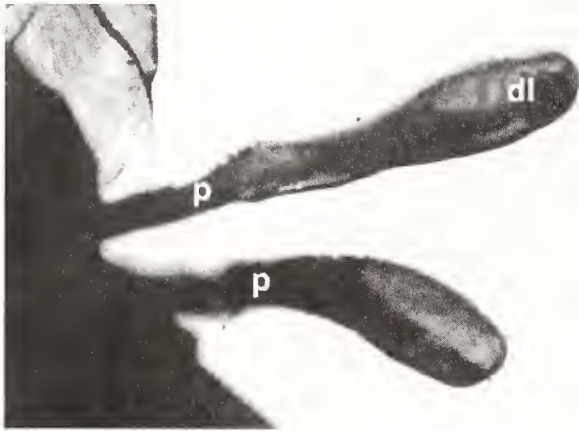


Fig. 5: Photograph showing the penal morphology of male *Branchinella nallurensis* sp. nov. dl – distal lobe; p – penis

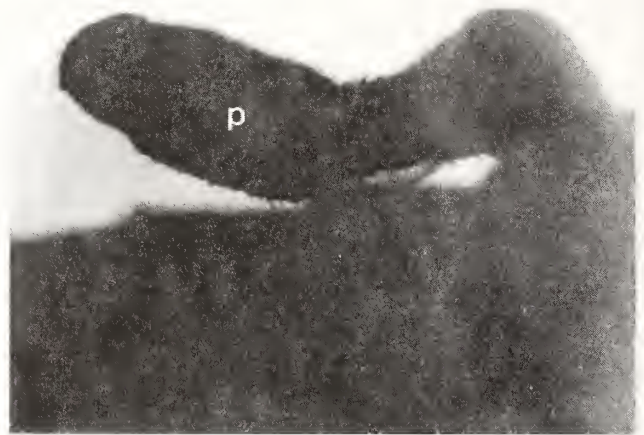


Fig. 6: Lateral view of the penal morphology (p) observed in male *Branchinella nallurensis* sp. nov.

surface, which is seldom found in *B. madurai*. Dorso-medial protuberances range to 6 in *B. madurai* and *B. kugenumaensis*, whereas in *B. nallurensis* sp. nov. the protuberances are 8 in number. Moreover protuberances are spiniform in *B. kugenumaensis* and *B. nallurensis* sp. nov.; they are digitiform in *B. madurai*. Basal joint possesses 3-5 small tubercles in *B. nallurensis* sp. nov., whereas *B. madurai* and *B. kugenumaensis* possess 6-11 and 5-8 tubercles, respectively (Table 1).

Male genital morphology shows unique characteristic features. The basal part of penis is long, widely separated and with a pair of lateral linguiform outgrowth. A single medial out-growth was seen in the inner side of non-retractile basal part of penis. Eversible part of penis is lengthier and bulged compared to that of the basal part and laterally set with a long row of prominent spines, which are sharp and flat structures (Figs 5, 6). Ventral, medial and dorsal surfaces are covered with spinules, which are denser at the distal region compared to the basal part. The penile structure is club shaped and extends up to the 3rd abdominal segment. In

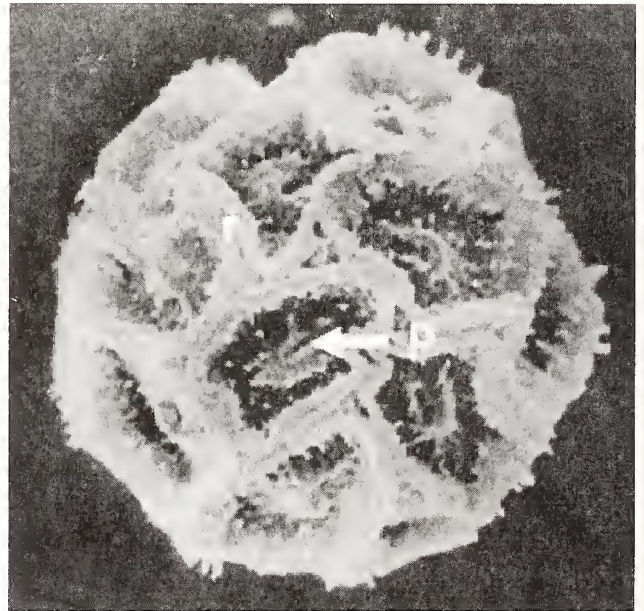


Fig. 7: Scanning electron micrograph showing the egg ornamentation of the new species *Branchinella nallurensis* p – pore; r – ridges

Table 2: Morphological variations observed in the peneal structure of different *Branchinella* species

<i>B. kugenumaensis</i>	<i>B. madurai</i>	<i>B. nallurensis</i> sp. nov.
Basal part shorter, widely separated with small medial process proximally	Basal part short widely separated with small medial process proximally	Basal part short widely separated with small medial process proximally. Eversible part is bulged compared to that of the basal part
Lateral set with a long row of prominent spines, conical near base	Conical lateral lobes almost as long as basal part. Laterally with long row of spines	Conical lateral lobes in the distal part
Sharp and flat in middle region scale like distally	Spines conical at proximal, scale-like distally	Lengthy spines, scale-like distally

Table 3: Morphological variations observed in the cyst of *Branchinella* species

	Overview	Ultra structure
<i>B. kugenumaensis</i>	Egg shell with irregular polygon	Minute pores on their surface
<i>B. madurai</i>	Egg shell with lip-like units covered with denticles	Denticles end with multiple spines
<i>B. nallurensis</i> sp. nov.	Egg shell with hexagonal ridges with a volcano-like structure in the centre	With single prominent pore with spine on the ridges

branchinellids, the morphology of penis is only occasionally presented (Quadri and Baquai 1956; Raj 1961; Tiwari 1971; Belk and Sissom 1992; Brendonck and Riddoch 1997), and is rarely described due to the difficulties in preparing specimens, and drawing and orienting the penile structures. Based on the penile structure (Table 2) we suggest that *B. kugenumaensis* and *B. madurai*, might belong to the North American species group which includes *B. sublettei* (Sissom) and *B. alachua* (Dexter); whereas, *B. nallurensis* resembles *B. ondonguae*, in which the basal part is slender and long, swollen distally (Brendonck 1997). Brendonck (1995a, 1997) proved the penile morphology as a valuable taxonomic tool in thamocephalidae and suggested use of this characteristic to diagnose each branchiopodid genus or when erecting a new genus, apart from conventional characters. Moreover, the relevance of using penile morphology to distinguish

anostracan genera was substantiated by referring the co-evolutionary nature of the penis (Brendonck 1995b).

Female fairy shrimp lacks frontal appendage. Second antenna is flat, small and rectangular unsegmented structure. Brood pouch is pear shaped and elongate up to the 3rd abdominal segment. Egg measures about 275-290 µm in diameter and scanning electron microscopic (SEM) study on the egg ornamentation reveals pentagonal shaped ridges with a prominent volcano-like pore in the center (Fig. 7, Table 3). Various studies have shown the importance of egg morphology while defining natural groups, which can provide taxonomic information (Thiery *et al.* 1995; Velu and Munuswamy 2005), due to their independent sexual selection (Belk *et al.* 1998).

Present taxonomic investigation clearly shows a marked variation in the male second antennae, penile and egg morphology in all three species of *Branchinella*. This led us to erect a new species, *Branchinella nallurensis* sp. nov. under the genus *Branchinella*. Besides this, through detailed molecular analysis by random amplified polymorphic DNA (RAPD) demonstrates and provides supportive information on their new species status (Velu 2001).

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